Florida Power & Light Company, 6501 S. Ocean Drive, Jensen Beach, FL 34957

April 9, 2008

L-2008-079
10 CFR 50.4
10CFR 50.55a

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Re: St. Lucie Unit 1
Docket No. 50-335
Inservice Inspection Plan
Fourth Ten-Year Interval Unit 1 Relief Request 3

FPL installed a reinforced vinyl ester liner on the bottom of the Unit 1 Refueling Water Tank (RWT) in 1994. The NRC approved the use of this liner as an alternative non-Code repair for the second and third ten-year ISI inspection intervals via approval of Relief Requests 13, RR-07, and RR-7A. The attached relief request is required to be submitted to address the use of the installed RWT liner during the fourth ten-year inspection interval. Relief is requested from the Repair and/or Replacement requirements of the ASME Boiler and Pressure Vessel Code, Section XI, 2001 Edition through the 2003 Addenda, Articles IWA-4000 and IWC-3000. In particular, Florida Power and Light (FPL) proposes to leave the installed fiberglass-reinforced vinyl ester liner in place on the Unit 1 RWT bottom, and to consider this installation as an alternative design equivalent to a Code repair or replacement of the RWT bottom. In support of this request, FPL proposes to continue to use an augmented inspection program for the bottom liner installation.

FPL requests that the attached relief request be approved by October 1, 2008 to support the upcoming fall 2008 Unit 1 refueling outage.

Please contact Ken Frehafer at (772) 467-7748 if there are any questions about this submittal.

Very truly yours,

Gordon L. Johnston
Site Vice President
St. Lucie Plant

Attachment

GLJ/KWF

A047
NRR

ST. LUCIE UNIT 1
REFUELING WATER TANK
REQUEST FOR ALTERNATIVE TANK BOTTOM DESIGN
(FOURTH TEN-YEAR ISI INTERVAL)

1.0 PURPOSE

A reinforced vinyl ester liner has been installed on the bottom of the Unit 1 Refueling Water Tank (RWT). The NRC has approved the use of this liner as an alternative non-Code repair for the second and third ten-year ISI inspection intervals via approval of Relief Requests 13, RR-07, and RR-7A. A new Relief Request is required to be submitted to address the use of the installed RWT liner during the fourth ten-year inspection interval. Based on the results of the inspections performed subsequent to the NRC approval of Relief Requests RR-07 and RR-7A, and the earlier examinations and tests, FPL is submitting a document to the NRC with the following purposes:

a. To demonstrate that the liner material presently installed on the St. Lucie Unit 1 RWT bottom reflects an alternative design which continues to provide acceptable levels of quality and safety which are equivalent to those provided by the original code of record.

b. To request continued approval of the installed liner material as an alternative design to be used on the tank bottom for the remaining duration of the tank life.

c. To establish the augmented inspection schedule (and types of inspections) proposed for the fourth 10-year ISI inspection interval to provide verification that the RWT liner will continue to perform its required functions.

2.0 COMPONENT IDENTIFICATION/LICENSING REQUIREMENTS

The Refueling Water Tank (RWT) is described in Section 6.3.2.2.1 of Reference 9.3. The RWT is an above ground storage tank which provides a source of primary grade borated water for refueling, reactor coolant makeup, and reactivity control during plant operations, and accident conditions (Reference 9.1, Sections 3.1.2.2, 3.1.2.8, and 3.5.4). The RWT is a Quality Group B, ASME Class 2 structure, and was designed and erected in accordance with ANSI B96.1-1967 (Reference 9.2).

St. Lucie Unit 1 Technical Specifications (Reference 9.1) require the RWT to maintain a sufficient supply of borated water in Modes 1, 2, 3, and 4 for injection by the Emergency Core Cooling System (ECCS) in the event of a Loss of Coolant Accident (LOCA); see Reference 9.1, Bases 3/4.5.4. The RWT provides the Technical Specification required minimum volume of 401,800 gallons of borated water, which ensures that 371,800 gallons are available for injection during emergency core cooling. A supply of borated water is also required for reactivity control in Modes 1, 2, 3, 4, 5, and 6 (Reference 9.1, Bases 3/4.1.2); this requirement can be met by either the Boric Acid Makeup Tanks or the RWT. The RWT

boron concentration is maintained at a minimum value of 1720 ppm to ensure an adequate shutdown margin with the reactor in cold shutdown with all Control Element Assemblies withdrawn (Reference 9.1, Section 3.1.2.8, and Reference 9.3, Section 6.3.2.2.1).

As documented in Reference 9.3, Section 6.3.2.2.1, NRC letter dated 5/27/97 approved the use of the vinyl ester liner (along with visual or hands-on inspections during each refueling outage) for the remainder of the second ten-year interval of plant operation. The use of the liner for the third ten-year interval was approved by the NRC on 6/18/99 as Relief Request RR-07. By letters dated 2/27/01 and 6/22/01, the NRC approved a change in the frequency of hands-on inspections to once every sixth refueling outage.

3.0 RELIEF REQUESTED

Relief is requested from the Repair and/or Replacement requirements of the ASME Boiler and Pressure Vessel Code, Section XI, 2001 Edition through the 2003 Addenda, Articles IWA-4000 and IWC-3000. In particular, Florida Power and Light proposes to leave the installed fiberglass-reinforced vinyl ester liner (installed in 1994) in place on the Unit 1 Refueling Water Tank (RWT) bottom, and to consider this installation as an alternative design equivalent to a Code repair or replacement of the RWT bottom. In support of this request, FPL proposes to continue to use an augmented inspection program for the bottom liner installation.

Via Reference 9.18 (5/27/97), the NRC authorized FPL's use of the RWT lining along with an augmented inspection program, in lieu of a Code repair or replacement, for the remainder of the second ten-year interval (which ended on 2/10/98). Via Reference 9.19 (6/18/99), the NRC approved Relief Request No. RR-07, which had been submitted by FPL requesting authorization for use of the tank lining along with an augmented inspection program, in lieu of a Code repair or replacement, for the third ten-year interval (2/11/98 through 2/10/08). Via References 9.22 (2/27/01) and 9.23 (6/22/01), the NRC approved Relief Request No. RR-7A, which had been submitted by FPL requesting authorization to change the augmented inspection program to specify hands-on inspection of the RWT liner every sixth outage (beginning with SL1-20) in lieu of every third outage.

Inspections of the RWT liner have been performed in accordance with the approved augmented inspection program. Based on the results of these inspections, FPL is requesting NRC approval for continued use of the installed fiberglass-reinforced vinyl ester liner during the fourth 10-year inservice interval (beginning 2/11/08) as an approved alternative design equivalent to a Code repair or replacement of the RWT bottom. In support of this request, FPL proposes to continue the augmented inspection program in accordance with the previously approved schedule. This will require that the RWT be drained and a hands-on inspection of the liner performed every sixth refueling outage (the next hands-on inspection would occur at SL1-26). During refueling outages for which a hands-on inspection is not performed, a remote visual inspection is required. (Note that the remote visual inspections may be performed with the unit on-line, within a period approximately three weeks before or following the designated refueling outage.)

4.0 BACKGROUND AND HISTORY

The background and history of the RWT bottom leak and the installation of the fiberglass-reinforced vinyl ester liner are documented in detail in Reference 9.25. The following is a summary of the background and history up to and including the submittal and NRC approval of revised Relief Request No. RR-7A in 2001.

In July 1993, a small leak approximately 3/16 inch in diameter was located in an area on the RWT bottom near the east side of the tank. Relief Request No. 13 was submitted to the NRC (Reference 9.4) requesting NRC approval for a non-Code repair involving the use of an epoxy coating to adhere an aluminum plate to the tank bottom over the hole. The non-code repair was implemented using a 1/8 inch thick, 3 inch diameter piece of aluminum plate and Duromar SAR-UW epoxy. Additional AE testing confirmed that there was no further leakage from the identified location (Reference 9.5). In the relief request, FPL committed to providing a code acceptable repair during the Fall 1994 refueling outage (SL1-13).

Engineering documents were prepared to support the implementation of a permanent code repair during the Fall 1994 Unit 1 refueling outage (SL1-13). This repair, as designed, involved removal of the section of the bottom plate which contained the identified leak and welding of a new 1/4" aluminum plate section to the existing bottom plate to cover the opening left by the removal of the temporarily repaired plate. When the bottom plate section was removed from the RWT bottom during the Fall 1994 outage, visual inspection revealed corrosion on the exterior surface; scattered pitting, and patches of a loosely adherent white corrosion product (likely aluminum oxide). During the installation of the new plate section, difficulties were experienced in completing the code repair. The wall thinning of the base material, coupled with conditions associated with welding inside the contaminated environment, led to localized defects. This resulted in an inability to qualify the welds; for this reason, the code repair could not be implemented.

As an alternative to the code repair, a fiberglass reinforced vinyl ester liner (Protecto-Line 800 system, manufactured by Dudick, Inc.) was applied to the inside surface of the RWT bottom. The liner system is a 1/8" (approximate) thick coating consisting of a prime coat, a trowelled base coat with a layer of fiberglass roving, and a top coat. Prior to application, the aluminum surfaces to receive the liner were abrasive blasted to obtain the specified surface profile and anchor pattern. The surface was inspected to ensure proper preparation for the application of the coating. The liner was applied over the entire tank bottom, and extended approximately 24 inches up the tank wall. The liner was visually inspected to verify proper installation. The installation of this liner system was performed during the Fall 1994 Unit 1 refueling outage in accordance with PC/M 128-194 (Reference 9.7). Personnel training, surface preparation, liner installation, and visual inspections were performed under the direction of FPL Nuclear Engineering's Coatings Specialist. The RWT was placed in service immediately following the installation and inspection of the liner material; the liner system has satisfactorily performed its required functions since its installation.

The liner installation is considered an alternative non-code repair. For this reason, FPL submitted Relief Request No. 13A to the NRC for approval of the use of this liner (Reference 9.8). In a

telephone conversation on November 16, 1994, the NRC provided verbal approval for the installation of this liner in the RWT. By NRC letter (Reference 9.9, 11/25/94), which also transmitted a Safety Evaluation Report, the NRC granted relief to install and use the Protecto-Line 800 system, stating that it would provide an acceptable level of quality and safety. In this letter, the NRC stated that, at the time of the Steam Generator Replacement outage (SL1-15), the RWT bottom would be replaced or repaired in accordance with the ASME Code. Additionally, the NRC stated that FPL had committed to the following:

a. Visual examination of the liner during each refueling outage.
b. Continued monitoring of the RWT for indications of leakage.
c. Completion of ongoing laboratory testing to confirm the ultimate capabilities of the lining.

Prior to the end of the refueling outage subsequent to the liner installation (SL1-14), these commitments were met as follows:

a. Visual examination of the liner

(See Reference 9.25) During the Spring 1996 refueling outage (SL1-14), the RWT was drained and a complete hands-on inspection was performed. The installed liner met all acceptance criteria, and showed no signs of degradation that could affect its ability to perform its required functions. Two minor anomalies were noted, neither of which constituted an unacceptable condition: a small hole (approximately 1/32 inch) that did not penetrate the topcoat layer, and a small piece of duct tape left on the wall and covered by the topcoat; both of these anomalies were repaired.

b. Monitoring for leakage

The level of the RWT is measured by LIS-07-2A. Annunciator Response Procedure 1-ARP-01-R23 (Reference 9.26) documents the required operator actions to be taken if the RWT level is either low or high.

c. Laboratory Testing

Discussion of the physical properties of the Dudick Protecto-Line 800 liner system (including results of laboratory testing) was documented in Reference 9.25, Section 6.3. The physical properties considered were:

- Adhesion strength
- Ability to bridge holes up to 0.5" in diameter
- Specific gravity
- Ability to accommodate "oil canning"
- Effects of radiation exposure on tensile bond test results
- Resistance to 5,000 ppm boron concentration
- Compressive strength
- Coefficient of thermal expansion

- Taber abrasion
- Flame spread
- Water vapor transmission
- Electrical resistance

The test results provided the necessary confirmation of the ability of the Dudick system to perform its intended functions as a liner for the RWT.

Samples of the liner material (primer, coatings, filler, hardener, and fiberglass roving) were subjected to chemical analysis to confirm the composition of the liner materials, and to determine whether the amounts of impurities in the materials are within the limits specified in plant procedures for materials used in the primary system. The results of this testing were documented in Reference 9.25, Section 6.4, and indicated that the Dudick Protecto-Line 800 liner is composed of materials specified by Dudick, Inc., and that the levels of impurities in the material are within the acceptance limits specified in Procedure ADM-02.01 (Reference 9.20).

Based on the information documented above and in Reference 9.24, FPL submitted Relief Request No. RR-07 requesting authorization for use of the tank lining along with an augmented inspection program, in lieu of a Code repair or replacement, for the third ten-year interval. This Relief Request was approved by the NRC via Reference 9.19 (6/18/99).

Following the hands-on inspection, remote visual inspections of the RWT liner were performed immediately prior to the two subsequent refueling outages (SL1-15 and SL1-16). These inspections were performed on October 17, 1997, and September 9, 1999. The liner was visually inspected for acceptability with regard to peeling, flaking, undercutting, blistering, and cracking. These inspections were performed utilizing a remotely operated submersible vehicle equipped with a camera; the visual signal from the camera was observed by the Nuclear Coatings Specialist and an Engineering representative. During each inspection, the RWT liner was found to be in an acceptable condition, with no observable degradation; it was concluded that the liner continues to provide the required levels of quality and safety equivalent to those provided by the original code of record. The complete reports of the results of the two remote visual inspections were documented in References 9.25, Attachments 12.18 and 12.19.

As documented in Reference 9.25, Section 6.2, the caulking compound between the RWT bottom and the concrete ring wall foundation was inspected in August-September 1996, December 1997-January 1998, and January-February 2000. An additional inspection was performed in December 2000-February 2001 (Reference 9.33). These inspections were performed to verify that corrective measures continue to prevent ingress of standing water or rain water beneath the RWT. These inspections typically showed minor isolated defects in the caulk layers (i.e., pinholes less than 1/16" diameter and minor separations approximately 1/32" wide between the caulk and adjacent surfaces. None of the defects observed were sufficiently extensive to have created the potential for ingress of substantial amounts of water underneath the RWT. After each inspection, the caulk was repaired as required, then re-inspected by Engineering.

Prior to SL1-17, FPL submitted Relief Request RR-7A requesting authorization to change the

augmented inspection program to specify hands-on inspection of the RWT liner every sixth outage (beginning with SL1-20) during the third ten-year inservice inspection interval in lieu of every third outage (Reference 9.21). This Relief Request was approved by the NRC via References 9.22 (2/27/01) and 9.23 (6/29/01).

5.0 ACTIONS SUBSEQUENT TO RELIEF REQUEST RR-7A

5.1 RWT Liner Inspections

Per the augmented inspection schedule approved via Relief Request RR-7A, remote visual inspections of the RWT liner were performed immediately prior to refueling outages SL1-17, SL1-18, and SL1-21, and immediately following SL1-19. The RWT was drained, and a full hands-on inspection performed, during SL1-20. These inspections were performed by the Nuclear Coatings Specialist and an Engineering representative, and have been documented in References 9.27 through 9.31. The results of the inspections are summarized as follows:

5.1.1 Visual Inspection Prior to SL1-17 (March 28, 2001):
(Reference 9.27, PMAI PM01-03-091) No peeling, flaking, undercutting, blistering, or cracking was observed. Some discolored areas (apparently due to external agents settling to the bottom of the tank) and boric acid crystals were observed; no evidence of deterioration of the liner was observed at these locations. The deceased body of a small toad was observed; this was addressed in Condition Report 01-0667, in which it was determined that no adverse effects on the RWT or on ECCS flows or accident mitigation capabilities would result.

5.1.2 Visual Inspection Prior to SL1-18 (September 24, 2002):
(Reference 9.28, MAI MA02-08-084) No peeling, flaking, undercutting, blistering, or cracking was observed. Some discolored areas (apparently due to external agents settling to the bottom of the tank) and boric acid crystals were observed; no evidence of deterioration of the liner was observed at these locations.

5.1.3 Visual Inspection Subsequent to SL1-19 (May 6, 2004):
(Reference 9.29, MAI MA02-09-094) No peeling, flaking, undercutting, blistering, or cracking was observed. Some discolored areas (apparently due to external agents settling to the bottom of the tank) were observed; no evidence of deterioration of the liner was observed at these locations.

5.1.4 Hands-On Inspection During SL1-20 (November 5, 2005):
(Reference 9.30, Condition Report 2004-15005) In accordance with the augmented inspection schedule approved via Relief Request No. RR-7A (which calls for full hands-on inspections every sixth outage), the RWT was completely drained during SL1-20, and a complete hands-on inspection was performed to evaluate the performance of the installed liner.

Prior to the refueling outage SL1-20, an engineering evaluation was prepared to provide the following information (Reference 9.32):

a. Procedures and acceptance criteria for the inspection of the vinyl ester liner installed on the RWT bottom.
b. Contingencies for minor repairs to be performed if the acceptance criteria for the inspections were not met.
c. A 10CFR50.59 applicability/screening demonstrating that the above activities were within the limitations of the 10CFR50.59 screening criteria and did not require prior NRC approval.

On November 5, 2005, during refueling outage SL1-20, an inspection of the bottom liner of the RWT was performed. The liner was inspected for acceptability of the following properties:

a. Hardness
b. Delamination
c. Adhesion
d. Peeling
e. Flaking
f. Undercutting
g. Blistering
h. Cracking
i. Checking
j. Discoloration
k. Holidays
l. Pinholes

The inspections performed on the RWT liner by the Nuclear Coatings Specialist and an Engineering representative were non-destructive in nature (except as noted in paragraph (a), below). The majority of the inspections were visual only. Some of the inspections (i.e., hardness, undercutting) involved the application of pressure with the edge or point of a knife or paint scraper; this did not result in any cutting of the liner surface. The inspections for delamination and adhesion involved physical sounding, in which the liner surface was struck with a hammer. The liner was only struck hard enough to enable the inspector to listen to the sound made; the force applied was insufficient to cause any damage to the liner.

Two issues were noted during the hands-on inspection:

a. Fourteen areas were found to exhibit minor hairline cracking. From visual observation, this was determined to be minor stress cracking. At the crack location judged to be the worst observed location, the crack was excavated with a hammer and chisel. The top layer of the vinyl ester liner was removed down to the fiberglass mat. The crack stopped before reaching the mat (i.e., the crack did not penetrate the top layer of the

liner). The width of the crack did not increase with depth. Subsequent to the inspection, the cracked areas were repaired in accordance with instructions provided in Reference 9.32. Each area was less than one square foot in area. At each location, the crack was opened into a "V" shape, and the surrounding sound liner material was sanded to provide a suitable profile. The repair area was then solvent cleaned with alcohol to remove water and other contaminants. The cracked area was then filled in with Duromar SAR-UW, and a square patch (3" minimum on each side) was provided with 100 mil (minimum) thickness of Duromar SAR-UW for additional structural strength and leaktightness. Duromar SAR-UW has been tested and approved as a repair compound for the installed liner material in this application (Reference 9.32).

The acceptance criterion for cracking (contained in Reference 9.32, Attachment 1) is that "the liner shall be considered acceptable if there are no areas of cracking observed". The definition of cracking provided in the same document is "small breaks in the liner which extend from the surface to the substrate". From this definition, it is noted that the condition observed during the SL1-20 inspection did not constitute an unacceptable condition as defined in the inspection criteria (i.e., the crack did not penetrate the topmost of the three layers constituting the Dudick protective liner). The areas in question were capable of maintaining zero leakage in their as-found condition; however, the cracks were filled in with Duromar SAR-UW to ensure that the floor structure will continue to maintain full design capabilities.

b. At the crack locations, there appeared to be potential minor anomalies of adhesion (as determined from soundings made with a ball-peen hammer). The extent of these anomalies was very limited, with the largest maximum dimension being approximately 15 inches (well within the acceptance criterion of 5 feet maximum). The excavated area showed no evidence of delamination between the top vinyl ester layer and the fiberglass mat. For these reasons, Elcometer adhesion testing was not considered to be required, and the tank liner was determined to be acceptable with regard to adhesion.

Based on the inspection findings documented in Reference 9.30 and the discussion above, the installed liner was determined to be acceptable. The minor anomalies noted were determined to be acceptable. Thus, the liner met the acceptance criteria for all of the properties listed above, and showed no degradation which could affect its ability to perform its required functions.

5.1.5 Visual Inspection Prior to SL1-21 (March 28, 2007):
(Reference 9.31, CR 2007-9187) No peeling, flaking, undercutting, blistering, or cracking was observed. Some discolored areas (apparently due to external agents

settling to the bottom of the tank) were observed; no evidence of deterioration of the liner was observed at these locations. The Duromar SAR-UW patches that had been installed during SL1-20 were closely examined during this inspection; there was no evidence of any unacceptable conditions observed in the patch areas, or in the liner material immediately surrounding the patches.

During each of these inspections, the RWT liner was found to be in acceptable condition. It is concluded that the liner continues to provide the required levels of quality and safety equivalent to those provided by the original code of record.

5.2 Additional Inspections

Relief Request RR-7A specified the inspections of the caulking compound between the RWT bottom and the concrete ring wall foundation to be performed on an annual basis to confirm that corrective measures continue to prevent ingress of standing or rain water beneath the RWT. The first additional inspection was performed in January 2002 (Reference 9.34). Beginning in September 2002, the annual inspections were performed under the Preventive Maintenance (PM) system; documentation records of the inspections performed from 2002 through 2007 are in References 9.35 through 9.41. (The inspection scheduled for November 2004 was not performed due to an RWT overflow spill that created elevated dose rates and contamination levels around the base of the RWT; this inspection was deferred to 2005). As in the previous inspections, minor defects were noted in the caulk layers. These defects typically consisted of isolated pinholes in the caulk and minor separation between the caulk and the adjacent surfaces. The extent of the defects was not sufficiently large to have created a potential for ingress of substantial amounts of water beneath the RWT. However, in order to prevent future problems in this area, the caulking was repaired as necessary.

6.0 ROOT CAUSE

In 1995, FPL's CSI Group performed an evaluation of the as-found conditions in order to determine the failure mechanism of the RWT bottom; this root cause evaluation was documented in Reference 9.25, Section 5.0, and in Reference 9.6. The conclusions and recommendations of the root cause evaluation are unchanged from those presented in Reference 9.25. To summarize, the conclusion of the root cause evaluation was that the failure mechanism of the RWT was galvanic corrosion (resulting from a galvanic couple between the exterior surface of the RWT aluminum alloy floor and the surrounding copper ground grid) which was manifested as pitting type attack. The root cause of the failure was determined to be the absence of a seal between the tank bottom plates and the concrete ring wall, which permitted the periodic ingress of water into the sand/oil cushion layer beneath the tank. This water likely contained dissolved salts which had been formerly deposited on the tank walls and the surrounding earth. As this water permeated the sand layer beneath the tank, it rendered the soil more conductive, thus increasing the susceptibility of the exterior of the tank floor plates to corrosive galvanic attack.

The root cause evaluation (Reference 9.6) included a recommendation for installation of a joint sealing compound between the tank bottom plates and the concrete ring wall to prevent further

ingress of water. This installation was performed via a controlled Work Order. Additionally, the area around the RWT was regraded to prevent standing water from rising to a level above the top of the ring wall foundation (Reference 9.10). Elimination of water from the sand layer beneath the tank will arrest further galvanic corrosion by eliminating the conductive electrolyte in contact with the tank floor and the ground grid. Further corrosion due to the presence of salts in the sand layer will be minimal if further water ingress is prevented.

7.0 EVALUATION OF PRESENTLY INSTALLED LINER

7.1 Design of the RWT Bottom

The RWT was designed in accordance with ANSI B96.1, "Welded Aluminum Alloy Field Erected Storage Tanks". The main base plates are 0.25 inches thick, and are welded to a 0.375 inch thick annular base plate. The tank is supported on an 8.5' high by 2' wide reinforced concrete ring wall foundation. The RWT base is anchored to the ring wall foundation with 45 two-inch diameter ASTM A36 carbon steel anchor bolts. (References 9.14 and 9.15)

The RWT bottom plates are continuously supported by structural fill material. There is a 6" thick sand and oil cushion placed on approximately 8 feet of Class I fill compacted to 95% of maximum dry density; underlying this is Class I fill compacted to 98% of maximum dry density (Reference 9.13). The tank shell is supported directly by the concrete ring wall and does not depend on the bottom plate for structural support. Per ANSI B96.1, the flat bottom of the tank is not subject to specific design rules for calculating minimum thickness and allowable stresses are not given for the tank bottom. The function of the bottom plate is to provide a barrier between the tank fluid and the underlying fill material. The bottom plate does not transfer loads to the shell or the annular base plate and ring wall foundation. Pressure stress loads are carried by the fill beneath the tank bottom. Therefore, the tank bottom may be considered a liner.

During the various repairs made to the RWT bottom, the support conditions of the bottom plate have not been changed from the original design.

7.2 Effects of Alternative Design on Quality and Safety

7.2.1 As discussed in Section 4.0, FPL performed confirmatory testing prior to the submittal of Relief Requests RR-07 and RR-7A to verify the manufacturer's published information concerning the physical properties of the Dudick Protecto-Line 800 system. These test results provide the necessary confirmation of the ability of the Dudick system to perform its intended functions as a liner for the St. Lucie Unit 1 RWT.

7.2.2 As discussed in Section 4.0, FPL performed chemical testing prior to the submittal of Relief Requests RR-07 and RR-7A to confirm the composition of the liner materials. The results of this testing indicate that the Protecto-Line 800

liner system is composed of the materials specified by Dudick, Inc., and does not exceed the acceptable limits for impurities as specified by FPL Administrative Procedures for materials in contact with the primary system.

7.2.3 The fiberglass-reinforced vinyl ester liner was installed during the Fall 1994 refueling outage (SL1-13). During the Spring 1996 refueling outage (SL1-14) refueling outage, the RWT was drained and a full hands-on inspection of the liner was performed. As discussed in Section 4.0 (and as previously reported), the liner met the acceptance criteria for all properties evaluated during this inspection, and showed no signs of degradation which could affect its ability to perform its required functions. Another full hands-on inspection of the RWT liner was performed during the Fall 2005 refueling outage (SL1-20), in accordance with Relief Request RR-7A. As discussed in Section 5.1.4, minor anomalies observed during this inspection were determined to be acceptable. Thus, the liner met all acceptance criteria, and showed no degradation that could affect its ability to perform its required functions. The installed liner has been determined to be acceptable.

7.2.4 As discussed in Sections 5.1.1, 5.1.2, 5.1.3, and 5.1.5, remote visual inspections of the liner were performed immediately prior to refueling outages SL1-17, SL1-18, and SL1-21, and immediately after refueling outage SL1-19 (these were the inspections performed subsequent to the submittal of Relief Requests RR-07 and RR-7A; as discussed in Section 4.0, remote visual inspections were also performed immediately prior to refueling outages SL1-15 and SL1-16). All of the above inspections were performed using a camera mounted on a remotely controlled submersible device. No evidence of any unacceptable conditions was observed during these inspections.

7.2.5 As discussed in Section 6.0, FPL performed a root cause analysis of the tank bottom corrosion mechanism prior to the submittal of Relief Requests RR-07 and RR-7A. The failure mechanism was determined to be galvanic corrosion resulting from a galvanic couple between the exterior surface of the RWT floor and the surrounding copper ground grid. The root cause of the failure was determined to be the absence of a seal between the tank bottom plates and the concrete ring wall, which permitted the periodic ingress of water beneath the tank. Corrective action was taken to eliminate this root cause by installing a joint sealing compound between the tank bottom plates and the ring wall. Inspections of the joint sealant compound installation have been performed on an annual basis (except where noted). The extent of minor defects, where observed, was not sufficiently large to have created a potential for ingress of substantial amounts of water beneath the RWT; any defects noted have been repaired to prevent future problems. Additionally, the area around the RWT was regraded to prevent standing water from rising to a level above the top of the ring wall foundation. By preventing further ingress of water beneath the RWT, further corrosion of the tank bottom due to the presence of salts in the sand layer will be minimal.

7.2.6 For the reasons discussed above, the Dudick Protecto-Line 800 system has been determined to be an appropriate material to be used as a liner for the aluminum RWT. Inspections of the liner (hands-on inspections, as well as remote visual inspections) have indicated no unacceptable degradation of the material since installation. Since the tank bottom does not transfer loads to the shell or to the annular base plate and ring wall foundation, it is considered a liner (i.e., a barrier between the tank fluid and the underlying fill material) in accordance with ANSI B96.1 (the design code of record). Therefore, the installed Dudick Protecto-Line 800 liner is considered an alternative design which is equivalent to the design originally installed per the code of record (ANSI B96.1), and will provide an acceptable level of quality and safety.

The liner material extends approximately 24 inches up the tank wall, which is a structural, load carrying element of the tank. As indicated in Reference 9.25, Attachment 12.1, Section 6.3(d) (prepared in support of Relief Requests RR-07 and RR-7A), the liner has exhibited the ability to accommodate approximately 3 to 4 inches of deflection on the tank bottom. This exceeds any bending deflection which will be experienced in the lowest 2 feet of the tank wall under postulated loading conditions. Therefore, loads causing stresses and accompanying deformations in the RWT wall will not result in loss of adhesion of the liner material to either the tank wall or the bottom.

7.2.7 The installed Protecto-Line 800 liner system continues to meet quality standards commensurate with the importance of the safety function to be performed (i.e., acting as a liner to retain the water in the RWT), as indicated by the following:

a. The liner was installed in accordance with Reference 9.7, which is a safety-related Engineering Package.

b. The liner material has been subjected to physical and chemical tests (as discussed in Section 4.0) to confirm its ability to perform its intended functions as a liner for the RWT.

c. Inspections of the liner (hands-on inspections, as well as remote visual inspections) performed subsequent to NRC approval of Relief Requests RR-07 and RR-7A have indicated no unacceptable degradation of the material since installation.

d. FPL is proposing to continue to utilize an augmented inspection program (see Section 8.0) to provide ongoing verification that the liner will continue to adequately perform its intended functions.

8.0 FUTURE PLANS

8.1 Planned Use of the Liner

Florida Power and Light proposes to continue to use the installed fiberglass-reinforced vinyl ester liner (Dudick Protecto-Line 800 system) in place on the Unit 1 Refueling Water Tank (RWT) bottom as a permanent alternative design, and also proposes to continue to use the RWT to meet its required Technical Specification functions.

The Unit 1 UFSAR (Reference 9.3), Section 6.3.2.2.1, states that the NRC has approved the use of the liner "as an alternative non-code repair" for the third ten-year interval.

8.2 Proposed Schedule for Inspection of Liner

8.2.1 The following inspections will be performed during the period encompassing the fourth ten-year ISI interval, which begins on February 11, 2008 and ends on February 10, 2018.

a. The intent of the inspection program will be to perform a full hands-on inspection of the RWT liner during every sixth refueling outage. To this end, a full hands-on inspection of the RWT liner will be performed during the SL1-26 refueling outage (the sixth refueling outage following the last hands-on inspection performed). (Via Relief Request RR-7A, the inspection program for the third ten-year ISI interval utilized full inspections during every sixth refueling outage; such inspections were performed during SL1-14 and SL1-20; see Sections 4.0 and 5.1.4). For this inspection, the RWT will be completely drained; inspectors will enter the tank to perform a hands-on inspection. These inspections will be similar to the inspection performed during SL1-14 and SL1-20. Inspections will be performed by the Nuclear Coatings Specialist (or designee) and an Engineering representative. The liner will be inspected for acceptability of the following properties:

- Hardness
- Delamination
- Adhesion
- Peeling
- Flaking
- Undercutting
- Blistering
- Cracking
- Checking
- Discoloration
- Holidays
- Pinholes

b. Beginning with the Fall 2008 refueling outage (SL1-22), and during every refueling outage for which a full, hands-on inspection is not scheduled (as specified in Section 8.2.1.a), a remote visual inspection of the RWT liner will be performed. As an option, the remote visual inspections may be performed with the unit on-line, within a period approximately three weeks before or following the designated refueling outage. These remote inspections may be performed with the use of a diver or a remotely operated submersible vehicle equipped with a camera. Inspections will be performed or observed by the Nuclear Coatings Specialist (or designee) and an Engineering representative. During these inspections, the liner will be visually examined for:

- Peeling
- Flaking
- Undercutting
- Blistering
- Cracking

8.2.2 The proposed inspection schedule outlined in Section 8.2.1 is only applicable through the end of the fourth ten-year ISI interval. A separate submittal will be made to the NRC regarding a proposed inspection schedule for the period beginning with the fifth ten-year ISI interval (which begins on February 11, 2018). The proposed inspection schedule will be based on the results of inspections performed up to the time of submittal, along with the documented performance of the RWT liner.

8.2.3 Should any RWT liner inspections indicate unacceptable results (in accordance with criteria similar to those contained in References 9.11 or 9.32), or if there are any documented occurrences of leakage through the RWT bottom, the inspection schedule (and types of inspections required) shall be revised as follows: a full hands-on inspection shall be performed during the first refueling outage following the unacceptable inspection results or documented leakage, and during every third refueling outage thereafter (through the end of the fourth ten-year ISI interval).

8.2.4 See Table 1 for summary of proposed augmented inspections.

8.2.5 Justification for Augmented Inspection Schedule

The RWT is outside of the primary containment; inadequate performance of the liner, however, could adversely affect the orderly and safe shutdown of the plant. Therefore, the RWT liner is considered to be Safety Related as defined by EPRI Document 1003102, Revision 1 (formerly TR-109937 – Reference 9.16), "Guideline on Nuclear Safety-Related Coatings" (Reference 9.42). The RWT liner was installed prior to the issuance of References 9.16 and 9.42; however, special process controls used during the installation of the liner are in compliance

with the EPRI Guidelines. The earlier EPRI Guideline (TR-109937) is referenced in USNRC Regulatory Guide 1.54 (Reference 9.17); the later version of the guideline (EPRI 1003102) is considered an industry guideline for coatings both inside and outside of containment.

EPRI guidance for the inspection of coatings is found in Reference 9.42, Section 8 ("Condition Assessment"). Table 8-1 recommends that the condition of ECCS water storage sources (e.g., the RWT) be assessed once every five years. It is also stated within the guideline that "once initial inspections have been conducted..., then the inspection scopes can be adjusted based on an analysis of the findings. Should inspections indicate satisfactory conditions, then frequencies of future inspections may be adjusted accordingly." The RWT was drained in 1996 (one and one-half years after the installation of the liner). A hands-on inspection of the liner was performed at that time by the FPL Nuclear Coatings Specialist and an Engineering representative. The liner was inspected for acceptability of the following properties:

- Hardness
- Delamination
- Adhesion
- Peeling
- Flaking
- Undercutting
- Blistering
- Cracking
- Checking
- Discoloration
- Holidays
- Pinholes

The liner met the acceptance criteria for all of the properties listed, and showed no signs of degradation.

The RWT was drained again in 2005 (six operating cycles after the original hands-on inspection) and inspected by the Nuclear Coatings Specialist and an Engineering representative. The liner met the acceptance criteria for all of the properties listed above, and showed no degradation which could affect its ability to perform its required functions.

In addition, remote visual inspections of the liner were performed by the Nuclear Coatings Specialist in 1997, 1999, 2001, 2002, 2004, and 2007 using a remotely controlled submersible device outfitted with a camera. The liner was inspected for peeling, flaking, undercutting, blistering, and cracking. During each of these inspections, the liner was found to be in an acceptable condition, with no evidence of degradation.

The RWT liner is a reinforced vinyl ester with an epoxy primer; the system has been evaluated and qualified for the required service. This type of system is widely used as a tank lining for conditions considerably more corrosive than that created by the slightly acidic borated water present in the RWT. The liner cures by a chemical reaction between the resin and the catalyst which cross-link to form a solid insoluble coating. Fiberglass and fillers have been incorporated into the design of this system to compensate for the shrinkage which takes place in vinyl ester when polymerization takes place. Potential issues that could adversely affect the liner's required performance parameters would be associated with delamination or loss of adhesion caused by shrinkage after installation. This condition would be accompanied by cracking, delamination, and/or blistering of the liner, and (if present) would have been discovered during the final inspection of the liner after installation. This liner has been inspected eight times since its original installation in 1994 (two hands-on inspections with the tank completely drained, and six remote visual inspections). During the second hands-on inspection in 2005 (SL1-20), several small areas of minor hairline stress cracking were observed. This cracking did not penetrate the topmost of the three layers constituting the liner system, and thus did not constitute an unacceptable condition as defined in the inspection criteria. The cracked areas were filled in with Duromar SAR-UW for additional strength and leaktightness, and to ensure that the floor structure will continue to maintain full design capabilities. Additionally, at the crack locations, potential minor anomalies of adhesion were noted. The extent of these anomalies was isolated and limited, and was well within the acceptance criterion. Where the cracks were excavated for the Duromar installation, there was no evidence of delamination between the top vinyl ester layer and the underlying fiberglass mat. These minor isolated anomalies were determined to be acceptable. Thus, the liner met all required acceptance criteria, and showed no degradation which could affect its ability to perform its required functions.

Due to the satisfactory performance of the installed liner material as verified through the augmented inspection schedule performed to date, it is proposed that this inspection schedule continue to be implemented. This proposed inspection schedule requires a hands-on inspection of the RWT liner once every six outages (approximately once every nine years); the next scheduled hands-on inspection would be during refueling outage SL1-26. In addition, a remote visual inspection would be required every outage for which a hands-on inspection is not scheduled (approximately once every 18 months); as an option, the remote visual inspections may be performed with the unit on-line, within a period approximately three weeks before or following the designated refueling outage. The use of the RWT liner with the continuation of the augmented inspection schedule is considered acceptable for the following reasons:

- The special process controls used during installation (under the direct supervision of the Nuclear Coatings Specialist).
- The material data of the liner, as verified through laboratory testing.

- The historical performance data of the liner.
- The results of the inspections performed to date.
- The nature of the water stored in the tank.

8.3 Inspection of Caulking Material

As discussed in Section 5.2, the conditions at the bottom of the RWT shall be inspected on an annual basis to verify that the corrective measures implemented (i.e., the caulking material between the RWT bottom and the concrete ring wall) continue to prevent ingress of standing or rain water beneath the RWT (Reference 9.12).

9.0 REFERENCES

9.1 St. Lucie Unit 1 Technical Specifications, through Amendment 203.

9.2 ANSI B96.1-1967, "Welded Aluminum Alloy Field Erected Storage Tanks".

9.3 St. Lucie Unit 1 Updated Final Safety Analysis Report, through Amendment 22

9.4 FPL Letter L-93-190 from D. A. Sager to U. S. Nuclear Regulatory Commission, dated July 30, 1993

9.5 Letter No. ESI-NDE-93-172, from C. M. Redding/S. M. Alberico to A. G. Menocal, "Final Report of the Refueling Water Tank, St. Lucie Unit 1, August 1993", prepared by Florida Power & Light Company, Nuclear Engineering, ESI, dated August 13, 1993.

9.6 Letter MET-94-227 from Mark Joseph (FPL Component Support and Inspection Group) to Dan Denver (FPL Nuclear Engineering), dated January 19, 1995.

9.7 PC/M No. 128-194, "Addition of a Reinforced Vinyl Ester Liner to the Bottom of the Refueling Water Tank", Revision 1.

9.8 FPL Letter L-94-291 from D. A. Sager to U. S. Nuclear Regulatory Commission, dated November 16, 1994.

9.9 Letter from Mohan C. Thadani (NRR) to Mr. J. H. Goldberg (FPL), "Subj: Proposed Alternative to the ASME Code for Replacement of the Refueling Water Tank Bottom at St. Lucie Unit No. 1 (TAC No. M90762)", dated November 25, 1994

9.10 Nonconformance Report (NCR) No. 1-741, dated January 22, 1993.

9.11 Safety Evaluation No. JPN-PSL-SECP-96-053, "Inspection Procedures and Repair Contingencies for the Refueling Water Tank Bottom Liner", Revision 0.

9.12 St. Lucie Action Report (STAR) No. 1-94110485, dated November 21, 1994.

9.13 Safety Evaluation No. JPN-PSL-SENP-93-035, "Evaluation of Inventory Loss from the Refueling Water Tank", Revision 2.

9.14 Drawing No. 8770-4510, "Refueling Water Tank - Bottom Details", Revision 5.

9.15 Drawing No. 8770-G-671, "Component Cooling Pumps Foundations - Masonry", Revision 9.

9.16 EPRI TR-109937, "Guideline on Nuclear Safety-Related Coatings", April 1998.

9.17 USNRC Regulatory Guide 1.54, "Service Level I, II, and III Protective Coatings Applied to Nuclear Power Plants", Revision 1, July 2000.

9.18 Letter from Frederick J. Hebdon (U. S. Nuclear Regulatory Commission) to Mr. Thomas F. Plunkett (FPL), dated May 27, 1997 [Subj: Safety Evaluation of St. Lucie Unit 1, Refueling Water Tank Bottom Epoxy Lining Relief Request (TAC No. M97706)].

9.19 Letter from Sheri R. Peterson (U. S. Nuclear Regulatory Commission) to Mr. Thomas F. Plunkett (FPL), dated June 18, 1999 [Subj: Relief from ASME Code Requirements Related to the Inservice Inspection Program Third 10-Year Interval for St. Lucie Plant, Unit 1 (TAC No. MA0965)].

9.20 FPL Administrative Procedure No. ADM-02.01, "Control of Chemicals and Materials for the Maintenance of Plant Systems", Revision 4.

9.21 FPL Letter L-2000-211 from Rajiv S. Kundalkar to U. S. Nuclear Regulatory Commission, dated October 18, 2000.

9.22 Letter from Richard P. Correia (U. S. Nuclear Regulatory Commission) to Mr. T. F. Plunkett (FPL), dated February 27, 2001 [Subj: St. Lucie Plant, Unit 1 – Evaluation of Relief Request 7A Regarding the Visual Inspection Frequency of the Refueling Water Tank Liner for the Third 10-Year Inservice Inspection Interval (TAC No. MB0324)].

9.23 Letter from Brendan T. Moroney (U. S. Nuclear Regulatory Commission) to Mr. J. A. Stall (FPL), dated June 22, 2001 [Subj: St. Lucie Plant, Unit 1 – Requested Correction/Clarification to Safety Evaluation Re: Relief Request 7A (TAC No. MB0324)].

9.24 Engineering Evaluation JPN-PSL-SECS-96-082, "Refueling Water Tank - Alternative Bottom Design", Revision 1.

9.25 Engineering Evaluation JPN-PSL-SECS-96-082, "Refueling Water Tank - Alternative Bottom Design", Revision 2.

9.26 Annunciator Response Procedure 1-ARP-01-R23, Revision 1.

9.27 PMAI PM01-03-091.

9.28 MAI MA02-08-084

9.29 MAI MA02-09-094

9.30 Condition Report 2004-15005

9.31 Condition Report 2007-9187

9.32 Engineering Evaluation PSL-ENG-SECS-05-053, "Inspection Procedures and Repair Contingencies for the Refueling Water Tank Bottom Liner (SL1-20), Revision 0.

9.33 PMAI PM00-02-091.

9.34 PMAI PM01-02-056.

9.35 Work Order 32012556.

9.36 Work Order 33008439.

9.37 Work Order 34007720.

9.38 Work Order 35009730.

9.39 Work Order 36010788.

9.40 Work Order 34022687.

9.41 Work Order 37007003.

9.42 EPRI Document 1003102, "Guideline on Nuclear Safety-Related Coatings", Rev. 1, November 2001.

TABLE 1

ST. LUCIE UNIT 1 -REFUELING WATER TANK PROPOSED SCHEDULE FOR INSPECTIONS FOR THE FOURTH TEN-YEAR INSERVICE INSPECTION INTERVAL

OUTAGE	REMOTE VISUAL INSPECTION (SEE SECTION 8.2.1.B)	FULL HANDS-ON INSPECTION (SEE SECTION 8.2.1.A)
INSPECTIONS PERFORMED DURING SECOND TEN-YEAR ISI INTERVAL (Ended on February 10, 1998)		
SL1-14		X
SL1-15 (SGR)	X	
INSPECTIONS PERFORMED DURING THIRD TEN-YEAR ISI INTERVAL (Ended on February 10, 2008)		
SL1-16	X	
SL1-17	X	
SL1-18	X	
SL1-19	X	
SL1-20		X
SL1-21	X	
INSPECTIONS PROPOSED FOR FOURTH TEN-YEAR ISI INTERVAL (February 11, 2008 – February 10, 2018)		
SL1-22	X	
SL1-23	X	
SL1-24	X	
SL1-25	X	
SL1-26		X
SL1-27	X	
SL1-28	X	

NOTES:

(1) The proposed inspection schedule outlined in Section 8.2.1 is only applicable through the end of the fourth ten-year ISI interval. A separate submittal will be made to the NRC regarding a proposed inspection schedule for the period beginning with the fifth ten-year ISI interval (which begins on February 11, 2018). The proposed inspection schedule will be based on the results of inspections performed up to the time of submittal, along with the documented performance of the RWT liner.

(2) If any inspections indicate unacceptable results, or if there are any documented occurrences of leakage through the RWT bottom, the inspection schedule shall be revised as follows: a full hands-on inspection shall be performed during the first refueling outage following the unacceptable inspection results or documented leakage, and during every third refueling outage thereafter (through the end of the fourth ten-year ISI interval).